June 23, 1964 A. G. DEAN 3,138,118

VEHICLE CONSTRUCTION FOR MINIMIZING COLLISION DAMAGE

Filed Oct. 20, 1961

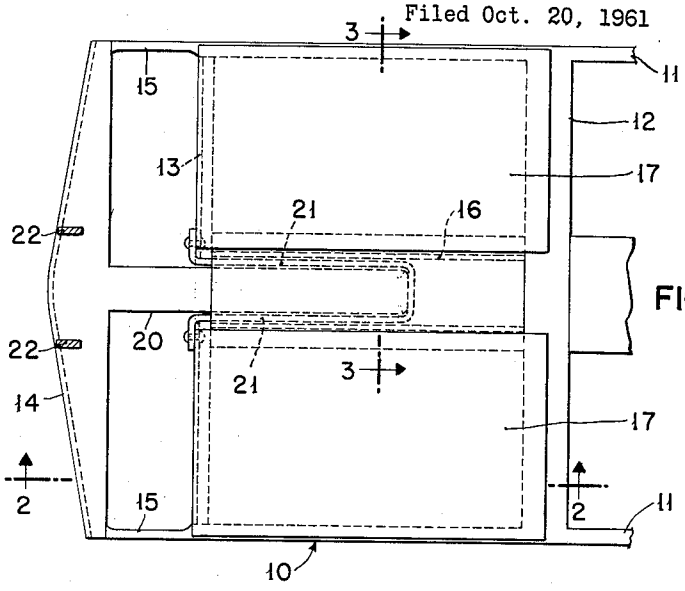


FIG. 1

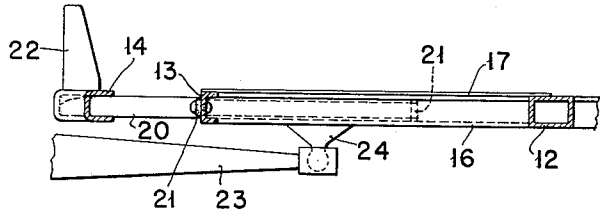


FIG. 2

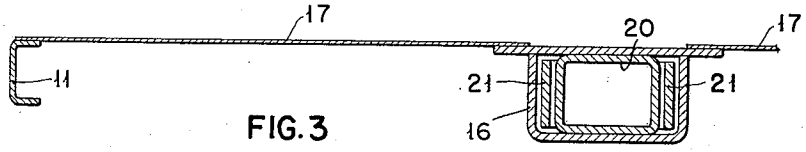


FIG. 3

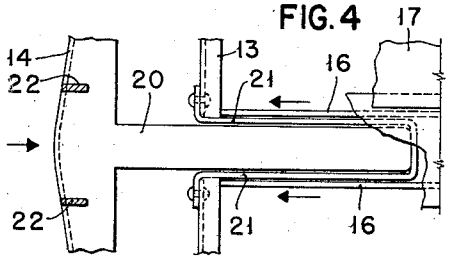


FIG. 4

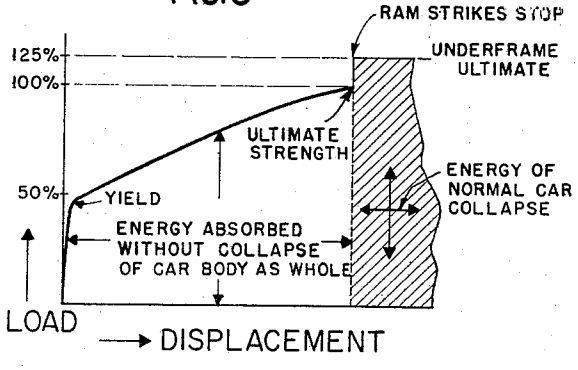


FIG. 5

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United States Patent Office 3,138,118 Patented June 23, 1964

3,138,118

VEHICLE CONSTRUCTION FOR MINIMIZING COLLISION DAMAGE

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Filed Oct. 20, 1961, Ser. No. 146,588
8 Claims. (Cl. 105—392.5)

This invention relates to a construction for vehicles subject to collision damage and has for an object the provision of improvements in this art.

One of the particular objects of the invention is to provide simple and effective means for absorbing considerable collision impact loads in the end frame of a vehicle to preserve the main car structure as much as possible.

A vehicle of usual construction—a railway car, for example—when subjected to collision forces at the end, will crush for a considerable distance from the end in order to absorb the energy of the impact. The vehicle structure is complex and difficult and expensive to repair, hence there have been some attempts to alleviate the situation.

One suggestion was to provide an end structure which would be easily crushable, but this is not a very satisfactory solution because not much of the energy is absorbed before the main structure is reached. The damage is merely slightly delayed.

According to the present invention there is provided an end structure which will crush initially when subjected to impacts of damaging collision magnitude and which will thereafter give progressively increasing resistance with relatively great energy absorption over a considerable displacement distance before the main structure is reached.

This is done in a simple and inexpensive manner by providing a secondary resistance element formed as a yieldable tension member having great strength over a relatively great distance after the yield point before rupture. Stainless steel is one form of material having the desired characteristics. One type, known as low tensile 301 stainless steel provides approximately 50% elongation with a yield point which is about half the ultimate tensile strength.

The above and other objects and advantages of the invention will be apparent from the following description of an exemplary embodiment, reference being made to the accompanying drawings wherein:

FIG. 1 is a top plan view, largely diagrammatic, of the end structure of a railway car embodying the invention;

FIG. 2 is a longitudinal vertical section taken on the line 2—2 of FIG. 1;

FIG. 3 is a partial transverse vertical section taken on the line 3—3 of FIG. 2;

FIG. 4 is a partial plan diagram; and

FIG. 5 is a load-displacement diagram.

Referring now to the drawing, there are shown portions of the underframe of a railway car **10**, the underframe comprising a main portion and an end portion. The main portion of the underframe comprises a pair of side sills **11**, a bolster **12** and a secondary end sill **13**. The end portion of the underframe comprises a main end sill **14** that is carried by relatively light compression members such as side sill end extensions or secondary side sills **15** which are strong enough for all normal service impacts but which are adapted to crush under collision impact loads.

A center sill **16**, formed of laterally spaced beams, rigidly connects between the bolster **12** and the secondary end sill **13**. Shear panels **17**, comprised of floor and other members, transmit buff and traction loads from the center sill to the main side sills.

A strong compression beam member or ram **20** has its outboard end securely connected to the main end sill **14** and its inner end is disposed between the spaced parts of the center sill **16**. A tension strip or strap **21**, here doubled around the inboard end of the ram like a sling, opposes the inboard movement of the ram. Its outboard ends are secured to the secondary end sill **13**.

As stated, this strip **21** has the special desired characteristics of great elongation and increasing strength above the yield point up to the point of rupture. Stainless steel, especially the low tensile 301 type, is one suitable material. Suitable materials are known from metallurgical tables. Brass, 201 stainless, Hadfield manganese, nickel base alloys such as Monel metal, and others may be noted.

A considerable space, at least equal to the elongation of the strip to rupture, when rupture is desired and less when rupture is not desired, is left between the inner end of the ram and the bolster **12**. After the strip breaks, or before, if rupture is not wanted, the inner end of the ram engages the strong rigid bolster member.

The end sill **14** has secured to its upper part a plurality of laterally spaced anti-telescoping posts **22**. The posts are attached with strong shear but flexible bending connections to the end sill so this may push back before the top of the post moves without straining or binding the ram.

To the bottom of the center sill there is secured a usual coupler shank **23** provided with a load limiting device, such as a shear pin **24**, which is adequate for all service loads but which will break under collision loads and thereby cause crash magnitude forces to be transferred to the end sill.

In crash or collision operation, the coupler shank **23** and the secondary side sills **15** fail at collision impact and thereby transfer load to the ram **20** and the tension strip **21**. The action is portrayed graphically in FIG. 5. The strip yields before much elongation has occurred but thereafter elongates very greatly while interposing increased load resistance up to the ultimate strength or rupture. Thereafter, and only thereafter, is the residual collision load brought directly into the main car structure by the ram striking the bolster. A great deal of energy is absorbed before failure of the strip and this may be enough to save the main car body structure completely.

The collision load is distributed over the ends of a number of cars (when present in a train of cars), the action being progressive from one end to the next as the one ahead passes above the yield point, and thus a great quantity of energy can be absorbed before any of the main car structure is damaged.

As an example, the tension strip or strap may yield at 200,000 pounds and stretch some 24 inches (50% elongation of a 48 inch strip) with the interposed resistance increasing gradually to failure at approximately 400,000 pounds.

The coupler shank pin, the secondary side sills and the light floor at the end will crush before much load is placed on the strip. The center sills are designed to take the top loading from the strip and transfer it into the main car body structure without damage. The center sill can run the full length of the car, that is, between the opposite secondary end sills **13**. Impact is partly a function of passenger load (where passenger cars are involved) and, while the passengers may be thrown about within the car, the present arrangement delays or avoids collapse of the occupancy space and thus reduces the chance of greater injury to passengers from this cause. The cross-section of the tension straps will, of course, be selected

in accordance with the particular materials used and the strength that it is desired they shall have.

It is thus seen that the invention provides simple and effective means for limiting the destructive effects of collisions in the main car body structure and for confining damage to the end structure which has been especially designed for easy repair. There is correspondingly greater safety for the passengers in the car.

While one embodiment of the invention has been described for purposes of illustration, it is to be understood that there may be various embodiments and modifications within the general scope of the invention.

What is claimed is:

1. A railway car construction for minimizing collision damage on the main body of the railway car comprising, in combination, an underframe comprising a main portion including main longitudinal frame members and interconnected transverse members and an end structure including transverse members and end longitudinal members, said end longitudinal members being weaker than the main longitudinal frame members and adapted to fail at an early stage of collision impact loading, and a tension member connected between said end structure and said main portion and arranged to take loads after failure of said end longitudinal members, said tension member having relatively great elongation beyond the yield point before failure, said main portion including a center sill providing a longitudinal guideway and a fixed stop at the inboard end of said guideway, and said end structure rigidly supporting a ram slidable in said guideway with its inboard end spaced at a distance from said fixed stop, said tension member being connected between said ram and said center sill.

2. A vehicle construction for minimizing collision damage on the main body of the vehicle, comprising, in combination with a main vehicle structure including a pair of side sills, a center sill, a bolster and a secondary end sill, said center sill having a longitudinal guideway, end structure including secondary side sills formed as extensions of said main side sills and of less strength than the main side sills so as to buckle in compression under collision impact loads, an end sill secured to the outboard ends of the secondary side sills, a ram secured to said end sill and slidable in the guideway of said center sill, and a tension strap connecting the inboard end of said ram to said secondary end sill, said tension strap having relatively great elongation beyond the yield point before failure and adapted, upon failure of said end structure due to collision impact, to stretch and thereby dissipate at least some of the collision energy.

3. A vehicle construction as set forth in claim 2, wherein said tension strip is formed of a material having approximately 50% elongation and an ultimate strength approximately twice the yield strength.

4. A vehicle construction as set forth in claim 2, wherein said tension strip is formed of type 301 low tensile stainless steel.

5. In a railway car in combination, with a main underframe structure, of first supplemental means located where it will be subject to primary collision impacts and formed to fail at collision impacts, and associated second supplemental means located and arranged to take collision loads subsequent to failure of said first supplemental means, said second supplemental means providing approximately 50% elongation before failure without reduction of absorbed load to absorb great impact energy and distribute it into the main frame before the direct impact reaches the main underframe.

6. In a vehicle construction in combination, with a main frame, of first supplemental means located where it will be subject to primary collision impacts and formed to fail at collision impacts, and associated second supplemental means located and arranged to take collision loads subsequent to failure of said first supplemental means, said second supplemental means providing approximately 50% elongation before failure with an increase of absorbed load up to rupture to absorb great impact energy and distribute it into the main frame before the direct impact reaches the main frame.

7. A railway car underframe comprising a main portion and an end portion; said end portion being connected to said main portion by structural members adapted to fail upon the application of predetermined collision forces longitudinally to said end portion; and means interconnecting said main and end portions for dissipating collision energy after failure of said structural members, said means comprising a ram rigidly connected at one end to said end portion and a strap fitted around the other end of said ram, said strap being of ductile metal whose ultimate strength is about twice as great as its yield point whereby said ram is adapted to elongate said strap after failure of said structural members, and thereby dissipate collision energy.

8. The invention of claim 7 wherein said main portion includes a center sill having a hollow end receiving said strip and the other end of said ram, and said ram and strap are arranged so that the strap can elongate to failure, whereupon said collision forces are transmitted directly to said main portion from said end portion.

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